

## CLAIMS

What is claimed is:

1. A process of producing a coke product, said process comprising:  
providing a coke precursor material;  
subjecting said coke precursor material to a thermal cracking process; and  
maintaining the ratio of asphaltic coke to thermal coke so as to promote the production of sponge coke;  
wherein said coke product is comprised of sponge coke in an amount in the range of about 40% to 100 % by weight.
2. The process of claim 1 wherein:  
said coke precursor material includes a volatile organic component; and  
said coke product has volatile combustible materials (VCMs) present in an amount in the range of from about 13% to about 50% by weight.
3. The process of claim 1 wherein the ratio of asphaltic coke to thermal coke is maintained by controlling at least one variable selected from the group consisting of coke precursor material characteristics, heater outlet temperature, coke drum temperature, coke drum pressure, coker recycle rate, coke drum thermal quench, coke drum chemical reaction quench, and combinations thereof.
4. The process of claim 3 wherein said coke drum thermal quench, said coke drum chemical reaction quench, or combinations thereof are added into a coke drum via injection systems selected from the group consisting of an existing anti-foam injection system modified drill stem, an injection lance at the top of the coke drum, and combinations thereof.
5. The process of claim 1 wherein said thermal cracking process is selected from the group consisting of delayed coking, Flexicoking, and other thermal cracking processes with by-product coke production.
6. The process of claim 1 wherein said coke product has porosity characteristics suitable for adsorption use.
7. The process of claim 6 wherein the adsorption characteristics of said coke product are improved by performing at least one step selected from the group consisting of :

decreasing the ratio of asphaltic coke to thermal coke;

including feed additives in said coke precursor material that are adapted to release low molecular weight gases during said thermal cracking process;

injecting low molecular weight gases into a coke mass in a coke drum at the start of a decoking cycle of said thermal cracking process;

hydroprocessing said coke product with sufficient hydrogen addition, temperature, pressure, catalyst activity, and residence time;

treating said coke product via chemical extraction of asphaltenes and resins with sufficient solvent, temperature, pressure, and residence time;

treating said coke product via chemical activation with sufficient chemical activator, temperature, pressure, and residence time; and

combinations thereof.

8. The process of claim 6 further comprising impregnating and/or adsorbing in said coke product at least one chemical compound having desired combustion characteristics and/or characteristics that otherwise enhance the fuel properties of said coke product.

9. The process of claim 8 wherein at least one volatile combustible material (VCM) is deposited via evaporation in said coke product and/or adsorbed in said coke product from a coke quench solution used in said thermal cracking process.

10. The process of claim 8 wherein at least one ionizing agent is deposited via evaporation in said coke product and/or adsorbed in said coke product from a coke quench solution used in said thermal cracking process.

11. The process of claim 8 wherein at least one oxygen-containing compound is deposited via evaporation in said coke product and/or adsorbed in said coke product from a coke quench solution used in said thermal cracking process.

12. The process of claim 8 wherein catalytic properties of said coke product are enhanced by the deposition via evaporation in said coke product and/or adsorption in said coke product of at least one catalyst or catalyst enhancement chemical from a coke quench solution used in said thermal cracking process.

13. The process of claim 6 wherein said coke product has sufficient adsorption character to be used for at least one adsorption application selected from the group

consisting of solvent vapor recovery, liquid purification, water purification, gas purification, air purification, and flue gas cleanup.

14. The process of claim 13 wherein said sponge coke has a honeycomb crystalline structure that is adapted to provide low pressure drop in said at least one adsorption application.

15. The process of claim 14 wherein said coke product is adapted to be removed from a coke drum in at least one section substantially without destroying the integrity of said honeycomb crystalline structure.

16. The process of claim 6 further comprising adding at least one chemical compound to said coke product to enhance adsorption characteristics of said coke product.

17. The process of claim 16 wherein:

at least one sulfur compound is added to said coke product by a process selected from the group consisting of adsorption and impregnation, wherein said at least one sulfur compound is adapted to enhance the adsorption of mercury and/or another toxic chemical from a gas stream.

18. The process of claim 1 further comprising adding to said coke precursor material at least one component selected from the group consisting of plastics, rubbers, and similar materials.

19. The process of claim 18 wherein said at least one component is added to said coke precursor material downstream of a feed heater via at least one system selected from the group consisting of grinding systems, pulverizing systems, and extruder injection systems.

20. The process of claim 6 further comprising adding at least one chemical compound to said coke product to enhance catalyst activity and properties of said coke product.

21. A coking process comprising:

providing a coke drum containing a coke mass and a vapor phase above said coke mass; and

injecting a quench medium in said vapor phase during a coking cycle;

whereby thermal cracking in said vapor phase is quenched during said coking

# 100% 100%

23. The process of claim 21 wherein:

said quench medium is injected via a modified drill stem positioned in said coke drum during said coking cycle and maintained at a level about 0.5 to about 10 feet above said coke mass.

adding at least one sulfur reagent to said petroleum coke; and

wherein said solid particles are adapted to be collected.

at least one sulfur reagent is added to said coke product by a process selected from the group consisting of adsorption and impregnation

said at least one sulfur reagent includes a compound comprising a component selected from the group consisting of earth metals and alkaline earth metals.

28. The process of claim 26 wherein said at least one sulfur reagent is selected from the group consisting of calcitic hydrates and dolomitic hydrates.

adding to a coke precursor material at least one component selected from the group consisting of plastics, rubbers, coal, wood, cardboard, paper, cellulosic materials, and similar materials;

297

from the group consisting of improved coke product yields, enhanced coke product adsorption character, and an alternative use (or recycle) of said at least one component.

30. A process of hydroprocessing coke, said process comprising:

providing a coke material comprising bonded chemical components from the group consisting of asphaltenes, resins, and condensed/polymerized aromatics; and

subjecting said coke material to chemical reactions from the group consisting of hydrogenation reactions, hydrogenolysis reactions, and cracking reactions via sufficient time, temperature, pressure, hydrogen, and catalyst activity to promote cracking and saturation of said coke material wherein said coke material produces cracked hydrocarbons and residual coke.

31. The process of claim 30 wherein said residual coke has at least one characteristic selected from the group consisting of greater porosity, less coke mass, and lower content of heterocyclic compounds than said coke material.

32. The process of claim 31 wherein said heterocyclic compounds are selected from the group consisting of sulfur, nitrogen, oxygen, and metals.

33. The process of claim 30 wherein said hydrogenation reactions, said hydrogenolysis reactions, and said cracking reactions are simultaneous.

34. The process of claim 30 wherein said coke material has sufficient porosity and internal surface area to provide said catalyst activity.

35. The process of claim 30 wherein solid-gas phase reactions sufficiently transfer hydrogen free-radicals in said hydrogenation reactions, said hydrogenolysis reactions, and said cracking reactions to reduce hydrogen partial pressure requirements of solid-liquid-gas phase reactions.

36. The process of claim 30 wherein said coke material is derived from crude oil.

37. The process of claim 36 wherein said process is promoted in a delayed coking process between a coking cycle and a decoking cycle.

38. The process of claim 37 wherein said delayed coking process utilizes at least 3 coke drums and at least 3 process cycles.

39. The process of claim 37 further comprising hydrotreating liquid hydrocarbons in at least one time period selected from the group consisting of before said process and

after said process.

40. A process of treating coke, said process comprising:

providing a coke material comprising at least one component selected from the group consisting of asphaltenes, resins, and condensed/polymerized aromatics;

subjecting said coke material to at least one chemical extraction reaction via sufficient solvent residence time, temperature, pressure, and catalytic activity to promote the removal of said at least one component from said coke material and to produce a residual coke with greater porosity than said coke material.

41. The process of claim 40 wherein said at least one chemical extraction reaction is controlled to promote pore sizes suitable for predetermined adsorption applications.

42. The process of claim 40 wherein the removal of said at least one component from said coke material is promoted in a delayed coking process between a coking cycle and a decoking cycle.

43. The process of claim 42 wherein said delayed coking process utilizes at least 3 coke drums and at least 3 process cycles.

44. A process of treating coke, said coke comprising:

providing a coke material comprising a porous, carbonaceous content; and

subjecting said coke material to at least one chemical carbonization reaction via sufficient chemical activator, residence time, temperature, pressure, and catalytic activity to produce a residual coke with greater porosity than said coke material.

45. The process of claim 44 wherein said at least one carbonization reaction is controlled to promote pore sizes suitable for predetermined adsorption applications.

46. The process of claim 44 wherein said at least one chemical carbonization reaction is promoted in a delayed coking process between a coking cycle and a decoking cycle.

47. The process of claim 46 wherein said delayed coking process utilizes at least 3 coke drums and at least 3 process cycles.